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Carbonate concretions in synkinematic Quaternary sediments as markers of paleo-fluid flow induced by the development of the Quattro Castella growth anticline, Northern Apennines, Italy

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Diagenetic alterations and synkinematic precipitation of mineral masses may provide a useful tool to understand paleo-fluid flows in transforming porous media. In compressive settings of a fold-and-thrust-belt, the presence of deep or blind thrusts could lead to the generation of folds that affects synkinematic sedimentation, superficial flow pattern and deep fluids migration.
In this contribution we present a multidisciplinary field and laboratory study on carbonate concretions developed in poorly lithified, synkinematic sediments of the Quattro Castella anticline in Northern Apennines, Italy. The study site is located along the Enza River, where Plio-Quaternary shallow marine to continental sediments are extensively exposed. The entire exposed section is a portion of the forelimb of the growing anticline, active since Late Miocene times. Field mapping was aimed to link bedding attitude of synkinematic sediments with the geometry, arrangement, shape and size of concretionary bodies. Concretions are both tabular (i.e. parallel to bedding) and elongate (i.e. plunging parallel to bedding dip). In situ permeability measurements and laboratory grain size analyses were performed along the studied section to characterize the petrophysical properties of sediments hosting carbonate concretions. Carbon and oxygen stable isotope analyses and petrographic observations were used to constrain the diagenetic environment during calcite precipitation. Our results indicate that the growing anticline promoted the development of a local hydraulic gradient which induced cement precipitation in the form of carbonate concretions in synkinematic sediments.